DEPARTMENT OF THE AIR FORCE
Air Force Office of Scientific Research (AFRL)
4015 Wilson Boulevard, Room 713 Arlington VA 22203-1954

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RESEARCH INTERESTS OF THE AIR FORCE OFFICE OF SCIENTIFIC RESEARCH And BROAD AGENCY ANNOUNCEMENT 2005-1

I. FOREWORD

The Air Force Office of Scientific Research (AFOSR) manages the entire basic research investment of the US Air Force (USAF). As a part of the Air Force Research Laboratory (AFRL), AFOSR's technical experts foster support and fund research within the Air Force Research Laboratory, university, and industry laboratories to ensure the transition of research results to support USAF needs. Using a carefully balanced research portfolio, research managers create new technology and advance current knowledge, enabling the Air Force and U.S. industry to produce world-class, militarily significant, and commercially valuable products.

In Fiscal Year 2004, AFOSR managed funding support for approximately 1,350 grants, cooperative agreements, and contracts, totaling $395 million, to about 380 academic institutions and industrial firms. This included grants to university scientists and academic institutions, contracts for industry research, and cooperative agreements. In addition, AFOSR-managed research programs funded and awarded by the Department of Defense (DoD), Defense Advanced Research Projects Agency (DARPA), and the Missile Defense Agency (MDA). The Broad Agency Announcement (BAA) for these programs can also be accessed through AFOSR's web page at **(http://www.afosr.af.mil)**.

AFOSR encourages the sharing and transfer of technology and welcomes proposals that envision cooperation among two or more partners from academia, industry, and Air Force organizations. Non-industry proposers should spell out in their proposals their interactions with industry and Air Force organizations, including specific points of contact. AFOSR also encourages proposers to cooperate with or use Air Force facilities; proposers should contact appropriate directorates in the Air Force Research Laboratory for this purpose. This document will guide proposers through AFOSR's research program and facilitate their preparation of research proposals.

AFOSR primary contacts' names, telephone numbers, mailing addresses, and e-mail addresses are provided at the end of each research interest, external program description, and special program description. If you have general questions about the Proposal Guidance, please contact Mr. Harry Haraldsen, AFOSR/PK, at (703) 696-5994, harry.haraldsen@afosr.af.mil or Ms. LaRue Merritt at (703) 696-5999, larue.merritt@afosr.af.mil.

Anyone qualified to perform research is encouraged to contact AFOSR in accordance with the appropriate BAA point of contact and the guidelines given in this document. AFOSR particularly encourages proposals from small business, historically black colleges and universities, minority institutions, and minority researchers.

Dr. Brendan B. Godfrey
Director, Air Force Office of Scientific Research

II. INTRODUCTION

The Air Force Office of Scientific Research (AFOSR) manages all basic research investment for the U.S. Air Force under this Broad Agency Announcement (BAA). To accomplish this task, AFOSR solicits proposals for research through this general BAA and specialized BAAs. Available BAAs are published in the Federal Business Opportunities **(http://www.fedbizopps.gov)** and/or Federal Grant Opportunities **(http://www.fedgrants.gov)**.

This BAA outlines the Air Force Defense Research Sciences Program and provides, for your convenience, a copy of the *Proposal Guidance* in Section VI. AFOSR invites proposals for research in many broad areas. Sections III and V of this document describe those areas in greater detail.

Specialized BAAs, like BAA 2004-3, "Fiscal Year 2004 Test and Evaluation (T&E) Research Program," outline specific programs in which the Air Force has a high interest or which target a specific section of the research community. The DoD/AF also periodically releases BAAs or program solicitations targeting small businesses involved in research through the Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) Program or the Historically Black Colleges and Minority Institutions (HBCU/MI) Program. The Fiscal Year 2004 listing of MIs may be viewed at **(http://www.ed.gov/about/offices/list/ocr/edlite-minorityinst.html)**. Portions of this document may also be applicable to the research opportunities described in the specialized BAAs. The current BAA and program solicitations are listed on the DoD University Research Initiative (URI) website **(http://www.dtic.mil/dtic/prodsrvc/urs.html)** or AFOSR's home page **(http://www.afosr.af.mil)** under "Research Opportunities." Availability of all BAAs is announced in the following websites **(http://www.FedBizOps.gov)** and/or **(http://www.fedgrants.gov)**.

Each BAA specifies deadlines, proposal formats, and other unique requirements. Unnecessarily elaborate brochures or presentations beyond those sufficient to present a complete and effective proposal are not desired. All proposals must be submitted in hard copy form directly to the office listed in the applicable BAA. Be sure to mark your proposal with the specific BAA number to ensure that it receives proper consideration. Information about current BAAs is available from the address listed below. In addition, the *AFOSR Proposer's Guide*, located in Section VI, describes procedures to follow when submitting proposals.

Before submitting a research proposal, you may wish to further explore proposal opportunities. You can do this by contacting the appropriate AFOSR program manager who can provide greater detail about a particular opportunity; the program manager may then ask for a preliminary proposal (see next paragraph). However, in your conversations with any Government official, be aware that only warranted contracting and grants officers are authorized to commit the Government.

If you would prefer (or if the program manager requests), you may submit a preliminary proposal, which should be in letter format and briefly describe the proposed research project's (1) objective, (2) general approach, and (3) impact on Department of Defense (DoD) and civilian technology. The letter may also contain any unique capabilities or experience you may have (e.g., collaborative research activities involving Air Force, DoD, or other Federal laboratories). Preliminary proposal letters should not exceed three typewritten pages; example figures and a one-page curriculum vita(e) for the principal investigator(s) may be attached.

This document is divided into six sections:

The *Introduction* describes the Broad Agency Announcement (BAA), the mechanism AFOSR uses to solicit research proposals. It also provides an overview of the general approach used to submit proposals. AFOSR's foreign research offices, in London (the European Office of Aerospace Research and Development--EOARD) and Tokyo (the Asian Office of Aerospace Research and Development--AOARD) also use this BAA. EOARD and AOARD manage programs that provide access to international research and research organizations of interest to the Air Force and other DoD agencies. In Fiscal Year 2004, EOARD and AOARD awarded over 131 contracts totaling $6.4 million to research universities and institutions from African, Asian, European, Middle Eastern, and Pacific Rim countries. (See **EOARD** and **AOARD** homepages for more information via the AFOSR home page at: http://www.afosr.af.mil under International Offices.)

The *Research Interests* section describes the primary subject areas of research that AFOSR is interested in sponsoring.

The *External Programs and Resources Interface* section discusses associateships, faculty, and graduate school research programs. Most of these programs are designed to foster the mutual research interests of both the Air Force Research Laboratory and institutions of higher education.

The *Special Programs* section emphasizes the importance of funding technical and scientific research efforts of Historically Black Colleges and Universities, Minority Institutions, and small businesses for the future of the basic research enterprise. AFOSR strives to provide opportunities to minority groups through programs that build infrastructure and ties to core research efforts. This section also explains AFOSR's support for workshops and conferences to give technical managers the opportunity to receive as well as transfer scientific, technical, and professional information.

The *Proposal Guidance* section is to be used in conjunction with the *AFOSR Proposer's Guide* for submitting a proposal in response to this announcement. The *AFOSR Proposer's Guide* can be found in AFOSR's website **(http://www.afosr.af.mil/oppts/afrprop.htm)**.

Address Information: We encourage you to obtain a copy of this BAA via the AFOSR home page website **(http://www.afosr.af.mil** or by e-mail **(info@afosr.af.mil)**. There will be a limited number of hard copies produced for individuals without access to the AFOSR home page. To request a hard copy, send a self-addressed label with your request to:

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Other AFOSR publications may also be downloaded from AFOSR's home page. Technical problems can be addressed to webmaster@afosr.af.mil.

III. RESEARCH INTERESTS

AFOSR plans, coordinates, and executes the Air Force Research Laboratory's (AFRL) basic research program in response to technical guidance from AFRL and requirements of the Air Force; fosters, supports, and conducts research within Air Force, university, and industry laboratories; and ensures transition of research results to support USAF needs.

The focus of AFOSR is on research areas that offer significant and comprehensive benefits to our national warfighting and peacekeeping capabilities. These areas are organized and managed in four scientific directorates: Aerospace and Materials Sciences, Physics and Electronics, Chemistry and Life Sciences, and Mathematics and Space Sciences. The research activities managed within each directorate are summarized in this section.

AFOSR seeks technical options that address our need for heightened attention to homeland defense and the Global War on Terrorism, funding those good ideas that are relevant to the Air Force role, and assisting in getting other good ideas to the agencies that may find them of special relevance to their roles.

Aerospace and Materials Sciences

The Directorate of Aerospace and Materials Sciences is responsible for research activities in aerospace, engineering, and materials. The four major projects in the directorate are solid mechanics and structures, structural materials, fluid dynamics, and propulsion. An equally important mission of the directorate is to support multidisciplinary efforts to meet Air Force science and technological needs. The structural materials activities in the directorate and the chemistry activities supported by the Directorate of Chemistry and Life Sciences form an integrated AFOSR structural materials program. The control theory and mathematical modeling research supported by the Directorate of Mathematics and Space Sciences complements many structural, fluid mechanics, and propulsion research programs supported by this directorate. Research areas of interest to the Air Force program managers are described in detail in the Subareas below.

Structural Mechanics

The objective of this research program is to create enabling technology for the development of Air Force systems by supporting fundamental studies that will expand the design space for future structures. There is also great interest in fundamental studies that will enable the Air Force to maintain the integrity and function of existing aerospace structures, as well as enhance their performance. Proposals are sought for studies that will enable the exploitation of large nonlinear structural deformations under coupled fluid, thermal, and mechanical loads. Examples include novel actuation devices and the exploitation of aeroelastic phenomena for flapping-wing micro air vehicles. The emphasis will be on gaining the understanding required to use nonlinear phenomena in novel ways, as opposed to, *e.g.*, simply characterizing flutter boundaries. Another major program thrust will be novel approaches to the design of reconfigurable structures. Both mechanical and materials (*e.g.*, shape memory alloys) based approaches are of interest. Novel structure concepts are of interest at any scale (nano, MEMS, large deployable structures) and for any purpose (sensing, controlling, stiffening, actuation, etc.) that supports air- and space-based applications. Other specific areas of interest include structural health monitoring and thermal protection systems. Other proposals, for structural innovations in areas not specifically mentioned above, are welcome.

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Mechanics of Materials and Devices

The main goals of this program are to develop safer, more durable aerospace vehicles/subsystems with improved performance characteristics; and to bridge the gap between the viewpoints from aerospace materials and devices on one side and aerospace structures on the other in forming a science base for the materials development process. Specifically, the program seeks to establish the fundamental understanding required to design and manufacture multifunctional aerospace material systems and devices and to predict their performance and structural integrity. The multifunctionality implies coupling between structural performance and other as-needed functionalities such as electrical, magnetic, optical, thermal, biological, and so forth. Structural integrity includes durability, survivability, reliability, and maintainability. This program thus focuses on developing and applying multifunctional mechanics principles and design methodology based on physics, chemistry, biology, and artificial intelligence to model and characterize the processing and performance of multifunctional material systems and devices at multiple scales. Projected Air Force applications require material systems and devices capable of sustained performance in complex or hostile loading environments. Such systems and devices often consist of different materials with different functionalities. Examples include hybrid structural materials, advanced fiber composites, solid rocket propellants, functionally graded material systems, and a variety of micro-devices. Innovative new material systems and devices, such as autonomic materials, nanocomposites, and micro/nano electromechanical systems, are also of interest. Interaction with Air Force Research Laboratory researchers is encouraged to maintain relevance and enhance technology transition.

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Unsteady Aerodynamics and Hypersonics

The unsteady aerodynamics and hypersonics research program is focused on providing the fundamental fluid physics research base for future aerospace systems. Through a balance of experiments, analytical modeling, and numerical simulations a fundamental understanding of the basic fluid phenomena associated with complex configurations is achieved. This increased knowledge base enables methods for flow prediction and optimization that, in the short-term, will reduce the weight and cost of future systems, and in the long-term, will enable completely new, revolutionary vehicle designs.

Unsteady aerodynamics is a key element in the development and optimization of future unmanned highly maneuverable air vehicles. Research areas of interest include understanding the basic mechanisms present in time-dependent aerodynamic flows, with emphasis on characterization, prediction, and control of separated and vortical flows. Nonlinear aero-structure interaction research, including approaches for control and suppression of destructive flow-structure interactions, is also of interest. Aero-acoustics research, especially as it applies to airframe noise or sonic fatigue, would also be considered a part of the aero-structure interaction emphasis.

Hypersonic aerodynamics research is critical to the Air Force's renewed interest in long-range

and space operations. The size and weight of a hypersonic vehicle, and thus its flight trajectory and required propulsion system, are largely determined by aerothermodynamic considerations. Research areas of interest emphasize the characterization, prediction and control of high-speed fluid dynamic phenomena including boundary layer transition, shock/boundary layer, and shock/shock interactions, and other phenomena associated with airframe propulsion integration. Real-gas effects, plasma aerodynamics, magnetohydrodynamics, and heat transfer in high-speed flows are also of interest.

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Turbulence and Rotating Flows

Research in turbulence and rotating flows is primarily motivated by Air Force requirements for airbreathing propulsion systems and advanced flight controls. In this context, the program seeks to advance fundamental understanding of complex, turbulent flows, and to apply that understanding to the development of physically based predictive models and innovative concepts for active flow control.

Research contributing to the understanding of flow instabilities and the mechanisms of transition from laminar to turbulent flow in both bounded and free-shear flows is of interest, especially as it relates to the impact on flow controllability and turbine engine flow fields. Improved turbulence modeling approaches are sought for the prediction of flow and heat transfer in highly strained turbulent flows. In this context, original ideas for modeling turbulent transport, especially ideas for incorporating the physics of turbulence into predictive models are sought. Improved subgrid models for large eddy simulations (LES) methods, especially in the near-wall region, and high quality turbulent flow data relevant to the advancement of transport and subgrid models for high-Reynolds number turbulent flows, are also of interest.

Research that addresses fundamental flow phenomena occurring in gas turbine engines, emphasizing the roles of unsteadiness, high freestream turbulence, multiple blade row interactions and three-dimensionality in determining the performance, stability, and heat-transfer characteristics of these flows, is encouraged. Methods for prediction and control of compressor instabilities, and aerodynamic forcing contributing to high cycle fatigue phenomena are of interest. Another principal concern is the prediction and control of heat transfer in gas turbines, including both film-cooling and internal-cooling flows. Other areas of interest include separation control, shock impingement effects, stagnation-point heating, blade tip clearance flows, and transition in high roughness, high freestream turbulence conditions.

Active flow control approaches based on understanding, modeling, and controlling fundamental flow processes are a focus area in this program. These approaches include the exploration of innovative sensors and actuation concepts, reduced order modeling, and fluids-based flow and flight control strategies, addressing a broad class of flow control problems related to fluidic thrust vectoring, internal duct flow tailoring, high lift, enhanced jet mixing, aero-optics, and drag reduction.

This program is also interested in ideas exploring frontiers in fluid mechanics relating to fundamental flow processes occurring in microscale devices.

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Combustion and Diagnostics

Fundamental understanding of the physics and chemistry of multiphase, turbulent reacting flows is essential to improving the performance of chemical propulsion systems, including gas turbines, ramjets, scramjets, pulsed detonation engines, and chemical rockets. AFOSR is interested in innovative research proposals that use simplified configurations for experimental and theoretical investigations.

The highest priorities are studies of supersonic combustion, atomization and spray behavior, fuel combustion chemistry, supercritical fuel behavior in precombustion and combustion environments, plasma-enhanced ignition and combustion, and novel diagnostic methods for experimental measurements.

In addition to achieving fundamental understanding, AFOSR seeks innovative approaches to produce reduced models of turbulent combustion. These models would improve upon current capability by producing prediction methods that are both quantitatively accurate and computationally tractable. They would address all aspects of multiphase turbulent reacting flow, including such challenging objectives as predicting the concentrations of trace pollutant and signature producing species as products of combustion. Approaches such as novel subgrid-scale models for application to large eddy simulations of subsonic and supersonic combustion are of interest.

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Space Power and Propulsion

Research activities fall into three areas: nonchemical orbit-raising propulsion, chemical propulsion, and plume signatures/contamination resulting from both chemical and nonchemical propulsion. Research in the first area is directed primarily at advanced space propulsion, and is stimulated by the need to transfer payloads between orbits, station-keeping, and pointing, including macro- and nanosatellite propulsion. It includes studies of the sources of physical (nonchemical) energy and the mechanisms of release. Emphasis is on understanding electrically conductive flowing propellants (plasmas or charged particles) that serve to convert beamed or electrical energy into kinetic form. Theoretical and experimental investigations focus on the phenomenon of energy coupling and the transfer of plasma flows in electrode and electrodeless systems under plasma dynamic environments.

Topics of interest include characteristics of pulsed and steady-state plasmas; scaling physics; characteristics of equilibrium and non-equilibrium flowing plasma; characteristics of electrical and hydrodynamic flows; instabilities of plasma bulk and wall layers; interactions of plasma-surface, plasma-electrode, plasma-magnetic, and plasma-electric fields; losses to inert parts; characteristics of plasmas in high-magnetic fields and pressures; and plasma diagnostics (new and unique non-interfering measuring techniques).

Research is sought on chemical propulsion to predict and suppress combustion instabilities in liquid rocket systems and pulsed detonation rocket engines. Topics of interest include the modeling of the coupling among unsteady flows, combustion, acoustic fields, and chemical kinetics, detonation phenomenon, modeling using novel tools such as molecular dynamics, direct simulation Monte Carlo, and hybrid approach.

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Metallic Materials

The objective of basic research in metallic materials is to provide the fundamental knowledge required to develop and improve metallic alloys for economically sustainable use in aerospace applications. Applications of these materials include aircraft gas turbine engines, engines for rocket propulsion, components of airframe and spacecraft structures, and hypersonic vehicle systems. This objective will be met by developing and verifying physics-based, quantitative, predictive models that relate processing, chemistry, and structure with properties and performance of metallic materials. Representative scientific topics include the development and experimental verification of theoretical and computational models of material processing and behavior, processing science, phase transformations, interfacial phenomena, strengthening mechanisms, plasticity, creep, fatigue, environmental effects, and fracture. Research on improved performance for low-cost operation and maintenance of metallic structural materials is also encouraged. Materials included in current projects include lightweight structural metals, refractory metals, intermetallic alloys, amorphous alloys and their composites, and micro-laminated materials.

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Ceramic and Nonmetallic Materials

The objective of this research program is to provide scientific background for current and future Air Force-related applications of ceramics, ceramic-matrix composites (CMCs), and carbon-based composites. Of particular interest are new ceramic materials that are lightweight and are high-temperature-resistant (>1500 °C) for application in structural elements for hypersonic aircraft and space structures. To facilitate their use, these materials' resistance to oxidation must be improved, and lower cost processing routes need to be developed. Incorporation of modeling and simulation into the design of new ceramic materials with superior mechanical properties (especially at elevated temperatures and under extreme chemical environments) is encouraged.

The incorporation of multifunctionality as an inherent property requirement of structural ceramic materials offers the immediate opportunity to improve performance by reducing weight and improving strength and toughness, while at the same time providing tools such as integrated detection, diagnosis, and repair modes. New approaches to designing multifunctional-structural ceramics are encouraged. Toughening techniques (i.e. phase transformation or texturing) that manipulate the ceramic microstructure are excellent opportunities to incorporate additional functionality into the material. In addition, new chemistries and processing techniques that have not been explored for multifunctional ceramics are prime candidates for designing a wide range

of smart structural ceramics (i.e. geopolymers, molten salt processing, hydrogen assisted processing and/or electric and magnetic field enhanced synthesis). One proposed model for a smart structural ceramic would be a material that is aware of its environment and is 1) self-monitoring, 2) self-diagnosing, and 3) self-repairing.

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Organic Matrix Composites

This program addresses the materials science issues relating to the use of polymer matrix fiber reinforced composites and related material technologies in aerospace and space structures such as airframes, engine components, rocket, launch vehicles and satellites. The goal is to provide the science and knowledge base that will lead to higher performance, more durable, more affordable structures for Air Force applications. The approach is to address issues relating to the development of improved performance or lower cost polymer-matrix composite (PMC) systems and the processing and the utilization of these structures during deployment. Chemistry and processing of structural adhesives and carbon-carbon structures are also within the scope of this program. Materials issues relating to all material preforms and processing leading to the end components are of interest. Examples of these include resin chemistry and formulations, prepregs processing, dry preforms, lay-up operation and cure processes.

Innovative material concepts that will lead to higher temperature and more damage-tolerant composites, lower cost processing and fabrication, and improved materials for space operations and launch vehicles are sought.

Current research interests include high performance adhesive and pre-damage nondestructive evaluation of adhesive bonded structures. High-temperature and/or low-shrinkage adhesives are needed to improve performance of high-temperature components and adhesive-bonded joints. New nondestructive evaluation methods that will probe chemical bonding integrity instead of macroscopic damage are of interest. Nanocomposite concepts that are relevant to improving or replacing current carbon fiber reinforced composites are of interest. The research targets in this area can address the matrix resin, fiber, ply or laminate level. Carbon-carbon concepts suitable for structural application in the temperature range of 700^{o} to 1200^{o}F, and material approaches to alleviate residual stresses and microcracking in composites, especially at cryogenic temperature range, are also areas of interest. Research that can improve the use of computational methods in accelerating new materials development and component design of polymer matrix composites is encouraged.

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Physics and Electronics

Research in physics and electronics generates the fundamental knowledge needed to advance Air Force operational capabilities in directed energy weapons; surveillance; stealth; electronic countermeasures; guidance and control; information and signal processing; and communications, command, and control. The program is of substantial breadth, extending from plasma and quantum physics, to the understanding of the performance of novel electronic devices, to maintaining device integrity in the harsh environment of space, to engineering issues such as those found in microwave or photonic systems or materials-processing techniques. One main objective of the program is to balance innovative science and Air Force relevance, the first element being forward looking and the second being dependent on the current state of the art. This directorate takes particular pride in the strong synergistic ties it has forged between university researchers and those in the Air Force Research Laboratory community. Research areas of interest to the Air Force program managers are described in detail in the subareas below.

ElectroEnergetic Physics

This Air Force program seeks innovative approaches and novel concepts that efficiently drive or cleverly exploit the collective interactions of charged particles with electromagnetic fields or the effects of resultant plasmas on their surroundings. Our primary interests currently encompass ideas for advancing the state-of-the-art in the following areas: electron-beam-driven sources of microwave and millimeter-wave radiation (high power microwaves (HPM) and/or vacuum electronics), compact pulsed power, particle-beam physics, plasma/pulsed-power/radio frequency (RF) bio-effects, next-generation combat simulation, power-efficient methods to generate and maintain significant free-electron densities in sea-level air, as well as particle-beam-related micro- and/or nano-device concepts.

Proposals for new compact pulsed power research must show technical linkage to this office's ongoing DoD FY01 Multidisciplinary University Research Initiative (MURI)[1] program on "Compact, Portable Pulsed Power." They should also relate to pulsed power efforts underway at Air Force and other defense laboratories (See Section V for a description of MURIs).

Research in the e-beam-generated microwave source area will address Air Force needs for communications, surveillance, electronics countermeasures, and/or directed energy weapons systems. New efforts should be synergistic with the ongoing FY99 "Innovative Vacuum Electronics" MURI and/or with the military's HPM research program.

Of particular interest, would be new ideas for micro-scale or nano-scale plasma and/or vacuum electronics device concepts. This does not include field-emitter area (FEA) research. Specifically, MEMS concepts that could be applied to a sensor/actuator system for a future "smart" microwave tube would be exceptionally interesting.

Of course, fresh ideas for completely new plasma-, vacuum-electronics-, or pulsed-power-related research areas are always of interest as long as Air Force relevance can be postulated. However, in general, this program is not interested in dense (strongly-coupled) plasmas, fusion plasmas, or space plasmas, since those topics are the subjects of focus for other agencies.

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Space Electronics, University NanoSatellites

This research program stresses Air Force requirements for advanced high performance electronic materials and devices. Depending upon the specific requirement, this calls for various combinations of higher efficiency, higher speed, higher power, lower noise, lower voltage/lower power performance and so forth. [It is useful for the proposer to learn of these Air Force needs and to point out how the ideas being put forward would address them.] There is greater emphasis given to analog devices than to digital and optoelectronic structures, which are covered in other programs at AFOSR and elsewhere in the DoD. Emphasis is shifting away from more 'traditional' compound semiconductor materials, such as GaAs and InP, to emerging materials such as the wide bandgap GaN family. Likewise, SiC materials and devices are not featured due to adequate coverage at other agencies such as DARPA and ONR. A particular interest is nitride-based electronic devices capable of high temperature operation, high RF power output and/or power density, high power-added efficiency and low noise figure. Effective electrical and environmental passivation of such devices is important as are other factors affecting device reliability and stability. Elimination of electronic dispersion in these devices remains an important challenge.

Proposals should avoid duplication of efforts at DARPA/MTO. However, convincing plans of working in coordination with this major program are regarded as positive proposal components. An emerging interest is that of materials and devices enabling 'reconfigurable' electronics. The objectives here are to devise electronic systems and circuits capable of operational flexibility and graceful degradation.

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Atomic and Molecular Physics

This program involves experimental and theoretical research on the properties and interactions of atoms and molecules. Atomic and molecular interactions with electromagnetic radiation and gravitational fields form the basic underpinning of a large range of technical applications addressing current and future Air Force needs. These include timekeeping, navigational guidance, remote sensing, secure communications, and atmospheric physics. Traditional Air Force efforts also include research in low- and high-altitude nuclear weapons effects, directed energy weaponry, and lasing mechanisms.
Specific research topics of interest include:

- Studies of the overlap between atomic and condensed matter physics – particularly the usage of atomic physics to learn about many-body phenomena
- The evolution of cold atomic systems into ultralow-density condensed matter systems
- The interaction of atoms and molecules with strong fields
- Cooling and trapping techniques applied to a broad range of problems, including high-resolution spectroscopy and cold atom collisions—particularly between atoms in excited quantum states.
- High-precision techniques for navigation, guidance, and remote sensing—particularly those suited to use in an orbital environment.
- The formation and evolution of cold (<1 K) plasmas.
- The dynamics of single, large molecules in complex systems.

- Antiproton capture, confinement, transport, injection, and annihilation processes—particularly those leading to the formation and storage of anti-hydrogen.
- Novel techniques for production of high-power microwaves, X-rays, and gamma rays.
- Cross-sections of atmospheric species.

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Remote Sensing and Imaging

This program investigates fundamental issues concerning remote sensing, including propagation and image formation processes. Topics include, but are not limited to:

- Remote sensing signatures and backgrounds, particularly sensing from space and observations of space objects from the ground, and the sensing of difficult targets such as targets under foliage, buried targets, etc.
- Enhancement of remote sensing capabilities, including novel solutions to system limitations such as limited aperture size, imperfections in the optics, and irregularities in the optical path.
- Theoretical foundations for imaging diversity methods (e.g., wavelength diversity, phase diversity, polarization diversity).
- Information-theoretic approaches to the general problem of unique image recovery from limited information about the object. Quantitative measures of convergence of deconvolution algorithms, estimates of tolerable noise in the reconstruction process, and number of iterations required to provide the "best" reconstructed image.
- Rigorous scattering models to describe the spectral and polarimetric signature from targets of interest using basic material physical properties with the goal of providing better understanding of the physics of the reflection or emission and the instrumentation requirements for next generation space surveillance systems.
- Propagation of coherent and incoherent electromagnetic energy through a turbulent atmosphere, including laser propagation for energy transport, imaging, and communication.

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Optoelectronics: Components and Information Processing

The current primary program thrusts include investigations in two affiliated areas: (1) the development of optoelectronic devices and supportive materials, and (2) the insertion of these components into optoelectronic computational and information-processing systems. Device exploration and architectural development for processors are coordinated; synergistic interaction of these areas is expected, both in structuring architectural designs to reflect advancing device capabilities and in focusing device enhancements according to system needs.

Research in optical materials and optoelectronic devices emphasizes the insertion of optical technologies into computing, image-processing, and signal-processing systems. To this end, this program continues to foster surface-normal interconnection capabilities, combining arrays of sources or modulators with arrays of detectors, with both being coupled to local electronic processors, often in "smart pixel" configurations. Understanding the fundamental limits of the interaction of light with matter is important for achieving these device characteristics.

Semiconductor materials and structures are the basis for the smart pixel and related device technologies. Numerous device approaches are part of the program as are techniques for optoelectronic integration.

System-level investigations incorporate these devices into processing architectures that exploit their demonstrated and envisioned attributes and determine appropriate problem classes for optical and optoelectronic approaches. The computational advantages and proper use of parallelism provided by optical implementations continue to guide architecture development. Computer interconnections continue to encounter increasing difficulty in signal transmission constrained by wire-crossing layout restrictions, electromagnetic interference, and cross-talk--impediments that may be circumvented by optical interconnect approaches. Alternatively, another program thrust emphasizes the use of the inherent, extremely high bandwidth of optical carriers by investigating systems that use multispectral data representations.

Fabrication of optical structures has now evolved to a precision, which allows us to control light within etched nanostructures. As semiconductor fabrication has matured so too has the crystal growth of quantum “boxes” for localizing electronic states in semiconductors. The combined engineering of electronic and optical “cavities” on the nanometer scale in semiconductors opens up several fruitful paths for advancing current and future technologies. The program is interested in the design, growth and fabrication of nanostructures that can serve as building blocks for nano-optical systems. The research goals include integration of nanocavity lasers, filters, waveguides, and diffractive optics, which can form nanofabricated photonic integrated circuits. Coupled to this area are optoelectronic solutions to enable practical quantum computing schemes.

In bridging the gap between electronics and photonics the program also explores opportunities in terahertz technologies. Diverse approaches have been taken to create THz sources and detectors over the 0.3 to 10 THz range. Desired are THz sources and detectors that are compact, efficient, solid-state devices capable of integration with other solid-state components. Integration of transmit and receive functions on the same chip is another goal. More specifically quantum well solutions are of highest interest.

This program supports Air Force requirements for information dominance by increasing capabilities in image capture; processing, storage, and transmission for surveillance; target discrimination; and autonomous navigation. In addition, high-bandwidth interconnects enhance performance of distributed processor computations that provide real-time simulation, visualization, and battle management environments.

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Laser and Optical Physics

Laser and optical physics research explores new ideas, knowledge, and insights in selected aspects and applications of these areas. Novel lasers and laser arrays, as well as nonlinear optical devices and phenomena are of interest. Application studies of microstructured optical fibers are ongoing and would be considered for expansion if funds are available. High brightness, narrow spectrum incoherent sources and arrays are also of interest directly for applications as well as for laser pumping. Ultrafast lasers and their applications are of interest, particularly small, lightweight, inexpensive, and high repetition rate sources, and applications to

materials processing and diagnostic imaging. Semiconductor laser arrays are being intensively investigated, together with associated optics, in the mid-infrared, in support of ongoing important Air Force development programs. Directed energy beams, particularly laser beams, are being explored in direct-write materials-processing techniques that offer broad and extremely important new capabilities, particularly in microelectronics and micromechanics fabrication and packaging, particularly for space. Adaptive optical devices and techniques are of interest, including large and micro-optical adaptive mirrors and mirror arrays, especially for space applications. Novel sources of monochromatic x-rays will be considered, particularly relatively small ones.

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Quantum Electronic Solids

This program focuses on materials that exhibit cooperative quantum electronic behavior, with the primary emphasis on superconductors, and on any conducting materials with surfaces that can be modified and observed through the use of scanning tunneling and related atomic-force microscopies, the ultimate goal being the creation of new nano-devices. The program also focuses on device concepts using these materials for dense non-volatile memory elements, electromagnetic detection and signal processing in Air Force systems. The long-standing materials aspects of this program are based on the fabrication, characterization, and electronic behavior of thin and thick superconducting films that ultimately can lead to the production of new and improved electronic circuit elements and high-current-carrying cables. The major focus of the program is on coated conductors to be used in producing tapes that will be formed into cables in power applications. Secondary objectives are to understand the mechanisms that give rise to superconductivity in selected ceramics and to produce high-quality Josephson tunneling structures. A continuing interest in this program is the search for new electronic device concepts that involve superconductive elements, either alone or in concert with semiconductors and normal metals. New fabrication techniques for the generation of LSI of ceramic Josephson junctions are likewise of interest. Discovery of practical higher-temperature superconducting materials remains an important goal.

A growing aspect of this program is the inclusion of scanning probe and other techniques to fabricate, characterize, and manipulate atomic-, molecular-, and nanometer-scale structures (including carbon and other elemental nanotubes), with the aim of producing a new generation of improved sensors and non-volatile, ultra-dense memory, resulting in the ultimate miniaturization of analog and digital circuitry. This program element includes the use of polarized electrons to produce nuclear magnetic polarization as a basis for dense, non-volatile memory, with possible application to quantum computing at room temperature.

An important recent addition to this program features the investigation of so-called “left-handed materials” (also characterized as negative-index materials) and how to utilize them to produce compact and efficient circuit elements for aerospace communications and surveillance systems.

Finally, there is a continuing interest in the development of new (soft and hard) magnetic materials with high energy products at elevated temperatures to aid in providing power devices, switches and bearings for a new generation of more-electric aircraft that dispenses with hydraulics.

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Semiconductor Materials

This research area is directed toward developing advanced optoelectronic and electronic materials and structures to provide improvements required for future Air Force systems. The focus is currently on growth and use of semiconductors in bulk structures, single heterostructures, quantum wells, superlattices, quantum wires, and quantum dots. Proposals are sought for significant advances in these areas, or expansion to novel application of materials such as organic polymers, amorphous, and polycrystalline materials, with estimates comparing potential improvements to present capabilities and the impact on Air Force capabilities. Wavelength ranges of interest span the spectrum from UV, visible, NIR, MWIR, FIR, and extending into the terahertz range.

Novel fabrication methods, in-situ and ex-situ characterization methods, and innovative substrates and materials that increase the integration density, or fill factor and efficiency are of significant interest, as are device structures that integrate cooling, or exploit designs that avoid heating. Nonlinear optics is another area of interest for increasing laser power at desired wavelengths, and protection from directed energy threats. Advanced optoelectronic and electronic materials will provide the building blocks for advances in laser and sensor applications and related components.

Compound semiconductors, heterostructures and other such materials are the foundation of new generations of wavelength-diverse, high sensitivity detectors, and lower power consumption, high-efficiency electric lasers, as well as high efficiency mutlijunction solar cells. These materials provide the properties necessary for improved space situational awareness, National and Theatre Missile Defense (NMD/TMD) capabilities, and space asset protection to support Space Control, and theater missile surveillance, threat warning and tracking, chemical and biological agent detection, improved satellite communications, and environmental monitoring as part of Space Force Enhancement. Innovative approaches are sought for lasers to provide, or advance, capabilities such as aircraft infrared countermeasures, laser communications, laser radar for precision guided munitions, illumination, chemical/biological agent detection, missile warning, sensor jamming, and laser array pumping. Innovative approaches are sought for sensors for applications such as target and background phenomenology characterization, threat identification, warning, and tracking, and protection of aerospace vehicles from electro-optic, infrared guided threats. Materials are needed to provide survivability to aircrews, sensor systems, aircraft, and space systems from directed energy threats.

Also of interest are the semiconductor systems that exhibit ferromagnetism, which may lead to semiconductor spintronic devices. An understanding of these materials is important to device development.

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Sensors in the Space Environment

We are interested in the interaction of Air Force systems and sensors with the space environment. In target detection, navigation, or communication, the intervening medium and the background become an integral part of the sensor system. Often the sensors themselves are affected by exposure to the space environment. The space environment can also actively participate in spacecraft electrodynamics. The goal is to understand how naturally occurring and artificial environmental phenomena influence the performance of systems and sensors, and to take advantage of the space environment to maximize their performance. The exploitation of the space environment requires a fundamental understanding of the physics of space, and of how the environment affects and is affected by electronic and mechanical systems.

New developments in Air Force systems for satellites and aircraft are requiring new approaches to the study of their environment. New spacecraft power and propulsion systems will take advantage of the environment as an energy source as well as for navigation. Innovative solutions to intra-satellite communication and ranging may include free-space laser links or terahertz propagation through structured or turbulent plasma at the poles or equator. New optical communication and identification techniques will drive the study of atmospheric turbulence and of atmospheric absorption and emissions. A more thorough understanding of expected energetic particle fluxes and electromagnetic radiation will be required as nano-scale electronics are included in spacecraft systems. Optoelectronic circuitry and memory will facilitate the storage and transmission of data sets that are orders of magnitude larger than current system capabilities and will require high speed and error free communication links through the intervening medium.

Research goals include, but are not limited to, characterization and understanding of the geospace environment as it relates to sensors and systems; development of active experiments to probe and exploit the space environment, specification, and prediction of the effects of terrestrial and space backgrounds and radiation on sensor performance; and understanding the electromagnetic characteristics of the environment to insure secure, wide bandwidth communication through the atmosphere and ionosphere as well as between satellites.

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High Density Optical Memory

There is a growing need within the Air Force for more and better computer data storage to support next generation processor architectures and new multi-media application software. This program thrust explores optical memory technologies that support page-oriented or holographic configurations in two or three dimensions. Capabilities of persistent spectral hole-burning systems for memory as well as for processing anchor this thrust. The spatiospectral attributes of this technology link "free-space" interconnect concepts to those of multispectral systems. Devices are being developed that emit, modulate, transmit, filter, switch, and detect multispectral signals, for both parallel interconnects and quasi-serial transmission. It is important to develop the capability to buffer, store, and retrieve data at the rates and in the

quantity anticipated by these devices.

Atomic and molecular absorption of light within semiconductor and optoelectronic materials is the basis for the technologies in the homogeneously broadened, generally cryogenic, optically resonant materials that support the memory development. Understanding the fundamental interaction of light with matter is important for achieving these characteristics. Architectural problems are also of interest that include, but are not limited to, optical access and storage in memory devices to obviate capacity, access latency, and input/output bandwidth concerns.

This program supports Air Force requirements for information dominance by increasing capabilities in image capture; storage, and processing for surveillance; target discrimination; and autonomous navigation. Further important considerations for this program are the airborne and space environment in which there is a need to record, read, and change digital data at extremely high speeds.

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Chemistry and Life Sciences

The Directorate of Chemistry and Life Sciences is responsible for research activities in chemistry and life sciences. A wide range of fundamental chemistry, biology, and behavioral research is supported to provide the Air Force with novel options to increase performance and operational flexibility. The chemistry effort in the directorate supports the structural materials activities in the Directorate of Aerospace and Materials Sciences to make an integrated AFOSR structural materials program. Although the program descriptions that follow are specific subareas of interest, there is interest in exploring novel ideas that bridge the disciplines. The interfaces between biology and chemistry, biology and physics, psychology and physics, or biology and behavior often provide the insights necessary for technological advances. Creativity is encouraged in suggesting novel scientific Approaches for our consideration.

Polymer Chemistry

The goal of this research area is to gain a better understanding of the influence of chemical structures and processing conditions on the properties and behaviors of polymeric and organic materials. This understanding will lead to development of advanced polymeric materials for Air Force applications. This program's approach is to study the chemistry and physics of these materials through synthesis, processing, and characterization. This area addresses both functional properties and properties pertinent to structural applications. Materials with these properties will provide capabilities for future Air Force systems to achieving global awareness, global mobility, and space operations.

Proposals with innovative material concepts that will extend our understanding of the structure-property relationship of these materials and achieve significant property improvement over current state-of-the-art materials are sought. Current interests include photonic polymers, polymers with interesting electronic properties, liquid crystals, bio-inspired materials and nanostructures.

In the area of photonic polymers, research emphases are placed on electro-optic and photorefractive polymers. Organic molecules with large multiphoton absorption cross sections are also of interest. It is desirable to increase the electro-optical coefficients of organic and polymeric materials with appropriate levels of thermal and temporal stability. Space operation issues of these polymers are also of interests. Control of speed and wavelength sensitivity in organic photorefractive polymers is currently supported. Examples of electronic properties of interest include conductivity, electrochromaticism, electroluminescence, electro-pumped lasing and superconductivity. In the area of structural properties, polymers with high thermomechanical properties are desirable. End uses of these structural polymers include aircraft and rocket components, canopies, coatings, and space structures. Issues relating to impact toughness and lifetime durability will be of special interest. Approaches based on biological systems to achieve materials properties that are difficult to achieve through conventional means are of interest. Current supports in nanostructures include controlling optical, electronic and mechanical properties and fabrication of submicron scale structures.

Material concepts that can improve on the above-mentioned optical, electronic, and mechanical properties of polymers are sought. These concepts include, but are not limited to, organic and polymeric materials, polymer blends, liquid crystals, and nanostructures.
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Surface and Interfacial Science

The objective of the Surface and Interfacial Science program is to improve the fundamental understanding of the structure and reactivity of surfaces and how they interact with their environment at the interface. This work will lead to a better understanding of the mechanisms involved in surface processes, and it will provide the foundation for the development of advanced surface structures and interfaces for future Air Force applications. The research funded under this program falls into four broad categories; surface chemistry, tribology, electrochemistry, and chemical sensing. This research investigates the basic chemical phenomena at the interface, including nucleation and growth of thin films and alloys (not to include semiconductors), friction and wear, lubrication, corrosion and materials degradation, sensing, electrochemical energy storage, and electrochemically induced reaction products and kinetics. The surface chemistry program includes efforts that are studying the mechanisms of corrosion of aluminum alloys and prevention of that corrosion. This work could potentially lead to new environmentally compliant coating systems for the protection of aging Air Force aircraft. The surface chemistry program is also funding efforts focused on the development of novel threedimensional nano-scale surface structures and systems for electronic, power, and sensing applications. Under the tribology program, research is supported into the solid, liquid, and vapor lubrication of surfaces. This work is designed to provide the Air Force with novel lubricants, lubrication systems, and wear-resistant coatings for current and future generation aircraft engines, and for micro-electromechanical (MEMS) systems in both terrestrial and space applications. The electrochemistry program has efforts investigating molten salt systems for the development of advanced materials and compact power sources for Air Force systems. Finally, work supported by this program includes chemical sensing of corrosion and wastes at the interfaces/surfaces of aircraft and their servicing environment. This may lead to development of new diagnostic tools that will alert technicians to areas of an aircraft that are experiencing corrosion, or it may provide new sensors that will help detect and monitor toxic materials and substances in the aircraft environment.

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Theoretical Chemistry

The major objective of the theoretical chemistry program is to develop new methods that can be utilized as predictive tools for designing new materials and improving processes important to the Air Force. These new methods can be applied to areas of interest to the Air Force including the structure and stability of molecular systems that can be used as advanced propellants; molecular reaction dynamics; and the structure and properties nanostructures and interfaces. Interest in advanced propellants is concentrated in the High Energy Density Matter (HEDM) Program, which aims to develop new propellant systems that can double the current payload capacity that can be put into orbit. Theoretical chemistry is used to predict promising energetic systems, to assess their stability, and to guide the efficient synthesis of selected candidates. These tools will help identify the most promising synthetic reaction pathways and predict the effects of condensed media effects on synthesis. This program is also seeking to identify novel energetic molecules and investigating the interactions that control or limit the stability of these systems. Particular interests in reaction dynamics include developing methods to seamlessly link electronic structure calculations with reaction dynamics, and using theory to describe and

predict the details of ion-molecule reactions and electron-ion dissociative recombination processes relevant to ionospheric and space effects on Air Force systems. Interest in nanostructures and materials includes work on catalysis, surface-enhanced processes mediated by plasmon resonances. This program also encourages the development of new methods and algorithms that take advantage of parallel computing architectures to predict properties with chemical accuracy for systems having a very large number of atoms that span multiple time and length scales.

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Molecular Dynamics

The objectives of the molecular dynamics program are to understand, predict, and control the reactivity and flow of energy in molecules. This knowledge will be used in atmospheric chemistry to improve our detection and control of signatures; in high-energy-density matter research to develop new energetic materials for propellants and propulsion systems; in chemical laser research to develop new high-energy laser systems; and in many other chemical systems in which predictive capabilities and control of chemical reactivity and energy flow at a detailed molecular level will be of importance.

Areas of interest in atmospheric chemistry include the dynamics of ion-molecule reactions relevant to processes in weakly ionized plasmas, atmospheric heterogeneous chemistry in aircraft and rocket exhausts, gas-surface interactions in space, and reactive and energy transfer processes that produce and affect radiant emissions in the upper atmosphere. Research on high energy density matter for propulsion applications investigates novel concepts for storing chemical energy in low-molecular-weight systems, and the stability and sensitivity of those energetic molecular systems. The coupling of chemistry and fluid dynamics in high speed reactive flows is also of interest. Research in energy transfer and energy storage in metastable states of molecules supports our interest in new concepts for chemical lasers.

Materials-related research includes the study of the synthesis, structure, and properties of metal-containing molecular clusters and nanostructures. Interest in nanostructures has particular emphasis on nanoscale systems in which the number of atoms or specific arrangement of atoms in a cluster has dramatic effects on its reactivity or properties. Also of interest are sensitive new diagnostic methods for detecting individual molecules and probing nanostructures. Fundamental studies aimed at developing basic understanding and predictive capabilities for chemical reactivity, bonding, and energy transfer processes are also encouraged.

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Chronobiology

This program supports research that provides a foundation for the development of effective measures to counter human fatigue, specifically fatigue induced by sustained wakefulness or by chronic sleep deprivation. Both circumstances are of concern to the Air Force because of

requirements for sustained operations or for shift work that is out of phase with natural biological rhythms (e.g. night operations).

Current efforts investigate the interaction of circadian and homeostatic systems in the regulation of cognitive and psychomotor performance. Human neurobehavioral data is used to develop and refine mathematical models of the circadian/homeostatic interaction. A comprehensive effort is underway to measure and integrate the various effects of behavioral routines, sleep scheduling, exposure to light, and wake-promoting pharmaceuticals.

The chronobiology program has very limited funding available for new projects. Preference is given to proposals that can contribute directly to new countermeasure developments or that open novel avenues for such developments. General investigations of circadian physiology, especially in areas supported by other federal agencies, are unlikely to be accommodated. New approaches that promise breakthroughs in understanding the cognitive and psychomotor consequences of sleep deprivation will be considered.

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Biomimetics, Biomaterials, and Biointerfacial Sciences

The goals of this biology, chemistry, and physics program are to study, use, mimic, or alter how biological systems accomplish a desired (from our point of view) task or to enable them to do a specific task in order to produce biomaterials and systems, which will enable future US Air Force technologies. This program not only wants to mimic existing biological systems, but also to create new capabilities in these organisms for more precise control over system production. The research will encompass three general areas: biomimetics, biomaterials, and biointerfacial sciences.

Biomimetic research is for enabling the development of novel sensors, engineering processes, and mechanisms. It will study the fundamental principles, processes, and designs of infrared sensitive biosystems at the sub-cellular, molecular and genomic levels to enable the further development of infrared materials, devices, and systems with enhanced structural and functional capabilities. Included are identify, model, and construct alternative biomimetic, near ambient infrared sensing devices. Finally, this program wants to probe and manipulate the functionality of alternative sensors for time-response characteristics, and adapts biochromophores and biophotoluminescent characteristics in microbial and protein-based biosystems for applications to military sensor systems.

The biomaterials area is focused on synthesis, structure, and properties of novel materials and nanostructures. Specifically, it will address either the mimicking of natural materials, using organisms as biomaterial factories of new materials, genetically altering existing organisms for new materials capabilities, or taking existing biomaterials/organisms and using them as novel materials like viral gradients or processing them further to make useful material as in biominerialization.

The biointerfacial sciences area is focused on new biosensors and bionanotechnology. Specifically, it will address the fundamental science at either the biotic-biotic or the biotic-abiotic interface. This will include both sensor arrays using combinatorial methods, and the

transduction of the desired event for display and processing. It includes most of the non-electromagnetic biosensor work as well as surface structure efforts down to the nanoscale for addressing bionanotechnology and biomesotechnology efforts.

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Cognition and Decision

This program supports research on high-order aspects of human information processing that contribute to skilled human performance. The overall objective is to describe quantitatively how humans process information to learn, recognize, assess, and make decisions about events occurring in dynamic environments. Specific objectives include, but are not limited to, the development of quantitative models and methods that improve our understanding of (a) multisensory perceptual integration, (b) cognitive and perceptual factors in the acquisition of complex skills, including motor skills, (c) team decision-making, and (d) the fundamental constraints of attention and memory on human performance. Of particular interest are models of individual and team behavior that are based on optimal rules for performing the task (such as detection or recognition, information search or integration, decision making, and resource scheduling, allocation, and coordination). A further specific objective is to improve our ability to identify and quantify the individual attributes that determine or constrain human performance, especially in complex information-processing environments. The study of these topics in conditions that involve uncertainty, high workloads, sustained operations, stress, or fatigue is encouraged. Multidisciplinary approaches are also encouraged, especially if useful in the development of quantitative or computational models of these human performance issues.

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Sensory Systems

The sensory systems program pursues an understanding of biological sensing mechanisms and investigates the integration of multiple sensory systems in human perception. Emphasis is on studies that can contribute the basic science foundation needed to inform new approaches to enhance human performance. This program supports research that coordinates empirical studies with mathematical or computational modeling. The development of theoretical models is desired, in part, for their eventual application to human factors problems, such as those that arise in the design of human systems to, for example, assist spatial orientation or navigation, find, track, and manipulate objects, or respond to acoustic information from multiple, simultaneous sources.

The current emphasis of this program is on the dynamic integration of multiple sensory inputs in human performance. One ongoing effort deals with the integration of auditory, visual, vestibular, and somatosensory inputs in response to non-standard gravito-inertial forces. Another deals with the coordination of head and eyes in tracking moving targets. A third effort studies several aspects of spatial audition, including sound localization, distance perception, and auditory cueing of visual search. The program is multi-disciplinary, drawing upon expertise in areas such as neurophysiology, computer and electrical engineering, biology, mathematics, and

experimental psychology. Applicants are encouraged to develop collaborative relationships with scientists in the Air Force Research Laboratory.

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Biological Response Profiling and Assessment

The Air Force develops and uses various physical and chemical agents that can interact with biological tissue and be potentially harmful to military and civilian personnel, to the surrounding populace, and to the environment. The agents primarily include non-ionizing radiant energies (radio frequency radiation, microwaves and laser light) and various chemicals that constitute fuels, propellants and lubricants of interest to the Air Force. Exposure to these agents may result directly from their use during Air Force operations and maintenance and, in the case of chemicals, may also occur indirectly, for example, as a result of leaky storage containers that contaminate streams, ground water, air, and soil.

To protect personnel, maintain hazard-free operational environments and develop safer materials, the Air Force supports basic research that endeavors to explore the interactions of these agents with biological systems at the cellular and molecular levels. The use of new technologies, such as transcriptomics, proteomics, and/or metabolomics, to characterize and assess the biomolecular response of cells to these agents is encouraged. Interpreting the data for mechanistic understanding and distinguishing between adverse and benign biomolecular response profiles will be especially challenging. Studies that can effectively combine novel experimental and computational techniques for the purpose of predicting toxicity will also be considered for support. Because the Air Force continually develops weapon technologies that depend on new chemicals and unique modes of radiant energies, it has become necessary to develop reliable, rapid and inexpensive methods for estimating health risks due to exposure. Mechanistically based in-vitro biomarkers combined with computational toxicology/chemistry represent research areas that may be particularly important in assessing health risks. Support of this kind of research is in harmony with an Air Force goal to minimize use of animals in research and to replace hazardous materials and processes with safe and effective alternatives. To accomplish these goals, this program promotes research that studies the interactions of biological systems with non-ionizing radiation and chemicals of unique interest to the military.

The following represent some basic research interests of the Air Force in Biological Response Profiling and Assessment:

I. CHEMICAL TOXICOLOGY
- A. Cellular/molecular mechanisms and biomarkers of toxicity
- B. Low dose, nonlinear response relationships
- C. Biomolecular response profiling
- D. In-vitro structure-activity relationships and their quantitative, computational and predictive implications
- E. Physiologically based pharmacokinetic (PBPK) modeling and metabolism of Air Force chemicals

II. LASER AND MICROWAVE RADIATION BIOEFFECTS
- A. Acute and chronic interactions of sub-nanosecond laser pulses with ocular and dermal tissues

B. Interactions of ultra wide band and high peak power microwaves with cells/tissues
C. Biomolecular response profiling
D. Biomarkers of exposure and effect
E. Biophysical and mathematical modeling of radiation-induced damage

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Mathematics and Space Sciences

The Directorate of Mathematics and Space Sciences is responsible for basic research in mathematical and computer sciences and space sciences in the areas described in this section. Many critical research activities are multidisciplinary and involve support from the other scientific directorates within AFOSR. Such activities include joint research with the Directorate of Physics and Electronics in the design of high-power microwave devices, and joint research with the Directorate of Chemistry and Life Sciences in intelligent tutoring and information fusion. The control theory and mathematical modeling research supported by this directorate complements many structural, fluid mechanics, and propulsion research programs supported by the Directorate of Aerospace and Materials Sciences.

Dynamics and Control

This program is devoted to basic research in dynamics and control, leading to improved techniques
for the design and analysis of control systems with enhanced capabilities and performance for insertion into future Air Force systems. Proposals should include connectivity to appropriate Air Force air, space, and information system applications, which currently include advanced high-performance aircraft, unmanned aerial vehicles, missile systems, precision munitions, satellites, spacecraft, and command and control systems.

The Dynamics and Control program is interested in robust and adaptive feedback control concepts including: adaptive, reconfigurable flight control systems; guidance, navigation, and control of autonomous aerial vehicle systems and teams; image tracking and robust feedback control in high scintillation environments; control for rapid and precision targeting; active control of electromagnetic radiation by mastering the properties of a propagating surface; control and optimal design issues in aeroengines; control of fluid flow processes associated with aerospace vehicles; control using advanced airborne and space-borne sensors and actuators; and novel hybrid control systems that can intelligently manage actuator, sensor, and processor communications in complex, spatially distributed systems. The program emphasizes research in robust and adaptive multivariable feedback control applicable to nonlinear systems; constrained and receding horizon optimal control; novel approaches to system identification; integrated control and multidisciplinary design optimization; control of complex coupled fluid-structure systems; and, to a lesser degree, fundamental applied research in stochastic control, and control of discrete event dynamical systems. In general, support for research in linear systems theory is decreasing, while interest in control of complex, multi-scale, highly uncertain nonlinear systems is increasing.

Increased interest exists in the development of control concepts applicable to single and multiple unmanned aerial vehicles (UAVs) and micro air vehicles (MAVs). Areas of interest include cooperative/collaborative control of a team of UAVs conducting operations such as cooperative combat ISR, electronic attack, urban warfare, wide area search/attack, and persistent area denial. Real-time, adaptive acquisition, classification, prosecution and assessment of geographically dispersed targets is envisioned, requiring cooperation amongst UAVs such that critical timing constraints are satisfied for optimal performance. A cooperative decision and control theoretic framework is of interest to address robust dynamic control of distributed UAVs executing multiple, strongly coupled tasks with a high degree of decentralization.

A long-term goal of the Dynamics and Control program is control for intelligent autonomy, in order to achieve a higher level of autonomous control. The main features of autonomous control systems are determined by the need to solve complex optimization problems in the presence of uncertainty, in near real-time and without human intervention. Providing UAVs and MAVs with faculties of wide field-of-regard perception will be a significant step toward the realization of autonomous control, and in this area research in vision-based guidance, navigation and control is of interest.

The dramatic increase in complexity of Air Force systems provides unique challenges for the Dynamics and Control program. Meeting these challenges will require interdisciplinary approaches to provide significant advances in methods and tools for modeling, simulation, analysis, and real-time control of multi-scale, hybrid dynamical systems. In this regard, concepts motivated from studies of biological organisms and processes are of interest.

A new area of interest includes those dynamics and control problems related to laser communications systems. This area primarily deals with space-borne communications systems that must close dual control loops from single points to single points and multiple points to single points without accurate prior knowledge of other systems' positions and while in a dynamic environment. Specific areas of interest include pointing, acquisition and tracking control, on-board control system algorithms and ancillary vehicle control problems.

The Dynamics and Control program places special emphasis on techniques addressing realistic treatment of physical applications, to include attention to constraints, scalability, complexity management, handling of system variations and environmental uncertainty, and real-time operation in extreme and adversarial environments.

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Physical Mathematics and Applied Analysis

This program conducts research in physical mathematics and applied analysis to develop accurate models of physical phenomena to enhance the fidelity of simulation. It investigates the properties of coherently propagating ultrashort laser pulses (both the currently examined IR frequencies and possible extension to UV frequencies) through the air and their exploitation in areas such as electronic warfare (ancillary production of HPM), laser-guided munitions (possible propagation through obscurants), and irradiation of chem/bio clouds. It develops algorithms to simulate nonlinear optical effects within fiber lasers (with weaponization in mind) and nonlinear optical mediaand studies feasibility of designing reconfigurable warheads by suitable placement/timing of microdetonators as well as the operation of pulsed detonation engines. The program pursues description of the dynamics of internal stores released from transonic or supersonic platforms as well as the fluid dynamics accompanying curved, rotating jet turbine blades. Also, it pursues the dynamics of the atmosphere near and above the tropopause with an emphasis on the understanding of turbulence and its production by topography and storms is of interest. Other areas of interest include the understanding of chaos in circuitry such as missile guidance systems, prediction of effective properties of various composite media, advanced fracture mechanics theories, which also include thermal loading such as might be produced by exposure to a strong laser.

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Computational Mathematics

This program aims to develop improved mathematical methods and algorithms that exploit advanced computational capabilities in support of Air Force scientific computing interests. For the most part, this program seeks to develop innovative methods and algorithms that improve modeling and simulation capabilities. These improved capabilities, in turn, enable understanding, prediction, and control of complex physical phenomena crucial to the Air Force. These phenomena include fluid mechanics, plasma dynamics, electromagnetic wave generation, combustion processes, structural dynamics, control of large flexible structures, processing and performance of composite and tailored materials and crystal growth. Research in the computational mathematics program enables technological advances in aerodynamics, airbreathing propulsion, space propulsion, high-power microwaves, high-power lasers and structural mechanics. Research also supports the national program in high performance computing.

This program is developing numerical methods and algorithms to fully exploit the potential of high performance computers in calculating fast, accurate numerical solutions of complex systems occurring in both the design and operation of Air Force systems. Efficient use of available parallel machines requires that we pay increased attention to dynamic resource allocation and load balancing, domain decomposition techniques, scalable parallel algorithms, adaptive meshing, and parallel schemes for adaptive grid generation. As the cost of hardware continues to decrease, the results of this program may affect the design of specialized architectures for solving critical scientific problems.

Typically, the computational models in this program rely on some numerical scheme that implements a discretization of continuum mechanics equations--generally partial differential equations--that represent the physics of the particular problem. However, alternative computational models may be appropriate for some problems. To characterize the behavior of large, complex, real-world systems, we are examining modeling approaches that enable efficient, robust multidisciplinary design analysis and optimization. Overall, this program is investigating both traditional and radical approaches in this program. This program develops and improves a variety of numerical methods in this sub area, including finite difference methods, finite element methods, spectral methods, lattice gas algorithms, particle and vortex methods, essentially nonoscillatory methods and hybrid methods.

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Optimization and Discrete Mathematics

Our goal is to develop mathematical methods for solving large or complex problems, such as those occurring in logistics, target tracking, engineering design, and strategic planning. These problems can often be formulated as mathematical programs. Therefore, research is directed at new linear and nonlinear programming methods, especially when formulated for the solution of selected Air Force problems, and innovative techniques that combine the use of artificial intelligence and operations research. Tracking problems are often formulated as optimal filtering and estimation problems that require novel approaches to handling multiple targets in

challenging environments.

This emphasis includes interaction between the collaborators, both human and machine. In addition, it will require new analytic techniques for development of robust plans under dynamic changes and uncertainty; that is, plans which perform well under a range of possible scenarios and can be changed to accommodate new conditions with minimal perturbation. This will enhance our existing research in robust optimization. In addition, modeling techniques to rapidly accommodate new information such as battle damage assessment and data fusion will be needed. These techniques should be designed to handle data that is possibly incomplete, conflicting, or overlapping. These models will view planning, execution, information acquisition, and replanning as a continuously evolving process.

Target tracking environments include multiple maneuvering targets in clutter, targets with low SNR, and cooperative tracking platforms. Computational complexity for real time applications is a key issue and competes with the need for accurate persistent tracks.

In addition to the evolution of traditional solution methods, the program supports new algorithmic paradigms (e.g., simulated annealing, genetic algorithms). Supported research includes discrete event systems, especially as it relates to Air Force transportation, target tracking, command and control systems, and battlefield management.

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Signals Communication and Surveillance

This research activity is concerned with the systematic analysis and interpretation of variable quantities that represent information, or convey information physically through a channel. Communications signals, enabling command and control, and surveillance images are of special importance. Signals are either naturally or deliberately generated and propagated by means of electromagnetic waves or other media, and are recaptured for use at a receiving sensor. Modern radar, infrared, and electro-optical sensing systems produce large quantities of raw signaling that exhibit hidden correlations, are distorted by noise, but still retain features tied to their particular physical origin. Statistical research that treats spatial and temporal dependencies in such data is necessary to exploit its usable information. An outstanding need in the treatment of signals is to develop resilient algorithms for data representation in fewer bits (compression), image reconstruction/enhancement, and spectral/frequency estimation in the presence of external corrupting factors. These factors can involve deliberate interference, noise, ground clutter, and multi-path effects. This AFOSR program maintains involvement with sophisticated mathematical methods, including time-frequency analysis and generalizations of the Fourier and wavelet transforms, that deal effectively with the degradation of signaling transmission across a channel. These methods hold promise in the detection and recognition of characteristic transient features, the synthesis of hard-to-intercept communications links, and the achievement of faithful compression and fast reconstruction for audio, video, and multi-spectral data. Continuous improvement in its repertoire of signal processing and statistical tools will enable the Air Force to maintain its lead in communications reach and air power projection, through responsive and cost-effective systems innovations.

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Software and Systems

The goal of this research program is to invest in the basic research needed to enable development of advanced computing science methods to support future Air Force needs in world-wide, 24-7 battlespace information management. Computing research is sought to meet several challenges including collection, control, and integration of the vast amounts of information flowing through battlespace information networks, protection of friendly information resources, and complexities in software and algorithm development in support of large information systems. Some specific areas of Infospheric Science research follow:

- Models of Information Flows
- Metrics for Information Flow
- Hierarchical Flow Models
- Information Dynamics
- Managing Massive Numbers of Triggers
- Information Pedigree/Certainty
- Stream data processing
- Automated Downgrading of Sensitive Information
- Preventing Self-Inflicted DoS Attacks
- Audit Data for Damage Assessment
- Steganography Detection
- Secure Code Composition
- Distributed, Assured Pipelines
- Application Layer Multicast Encryption
- Seamless Integration of Wireline-Wireless Networks
- Network monitoring, measurement, and inferencing
- Ad Hoc Wireless Networking
- Middleware
- Joint Battlespace Infosphere (JBI) System Stability
- Dynamic System Management
- JBI Information Metadata and Structure
- Evolvable Components

The need to collect, integrate, and disseminate information from widely disparate sources will be crucial in future military operations. Deep information extraction from all sources of data is a growing area of interest. For network protection, researchers will focus on determining and analyzing network security properties at all network layers and examining how to ensure that a network possesses these properties. New approaches to detection of intrusion, forensics, and an active response and recovery from an attack on information, are needed. Basic research that anticipates the nature of future information system attacks is critical to the survivability of these systems. Research on effective security policies across large, heterogeneous infospheres is of high interest. Techniques to automatically detect deceptive data or information are of interest. In the area of software and algorithm development, the program seeks mathematical approaches for the specification, design, and analysis of distributed software systems. Rigorous mathematical methods, especially those that involve aspects of timing, control, dependability, scalability and security, will be crucial to development of future battlespace infospheres. New approaches for overcoming the increasing computational complexity of these systems are essential.

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Artificial Intelligence

The timely management of information and the ability to make decisions based on that information is of paramount importance within this program. The key issue that is addressed is how to effectively incorporate all available information, from diverse sources and modalities, into the decision process. For example, mathematical foundations of information fusion must be established -- robust, integrated fusion architectures for handling increasing diversity of input sources are especially important. Information fusion, above the sensor level, to include situation refinement, impact assessment and process refinement is a major focus. Research is sponsored into how to make the best use of uncertain information; share and disseminate information; increase the accuracy, speed, and economy of the recognition and identification process; and aid the intelligence analyst.

The program concentrates on research needed to develop large-scale intelligent systems that can address practical Air Force needs. To that end, means are sought to scale up those methods that work for small knowledge-based systems. One goal is to overcome present limitations in the amount of knowledge used because of knowledge acquisition and management deficiencies. Present limitations on meaningful systems adaptation and system improvement with use also need to be overcome. Formalisms need to be developed for the representation of and reasoning with uncertainty, in handling corrupt information, identifying deceptive information, and effectively using experiences.

To aid the information analyst in fusing information from diverse modalities, we seek means to combine numeric and symbolic inference methods. Research could also focus on integrating probabilistic reasoning methods with traditional formal logic methods, and perhaps with other forms of computation. Qualitative methods that will drastically simplify computation and increase performance robustness are also of interest.

The program seeks to develop technology that will support decision-making. To that end, research is needed to develop intelligent agents capable of gathering information, reducing data to a manageable amount of essential information, and cooperating with other agents to solve problems. Research is also needed to combine artificial intelligence methods with operations research tools to overcome inefficiencies in solving some mission-critical Air Force problems (e.g., scheduling in a distributed, dynamic environment).

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Electromagnetics

Conduct research in electromagnetics to produce conceptual descriptions of electromagnetic properties of novel materials/composites (such as photonic band gap media) and simulate their

uses in various operational settings. Evaluate methods to recognize (the inverse scattering problem) and track targets and to penetrate tree cover or other dispersive media with wide band radar (propagation of precursors for example) and design transmitters to produce such pulses. Develop computational electromagnetic simulation codes that are rapid and accompanied by rigorous error estimates/controls.

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Space Sciences

The AFOSR Space Sciences program seeks basic knowledge of the space environment to apply to the design and calibration of Air Force systems operating in and through space. For AFOSR purposes, the space environment begins at the base of the Earth's ionosphere, at an altitude of approximately 80 km (50 miles). Both the nominal and disturbed space environment can disrupt the detection and tracking of aircraft, missiles, satellites, and other targets, distort communications and navigation, and interfere with global command, control, and surveillance operations.

The physical and chemical behavior of the Earth's upper atmosphere affects the performance and longevity of Air Force systems operating in low-Earth orbit. Among other themes, AFOSR will consider research proposals related to:

- Ionospheric plasma turbulence and dynamics;
- Observing and modeling neutral winds, atmospheric tides, and gravity waves in the ionosphere;
- Variations in solar radiation received at Earth and their effects on satellite drag;
- Geomagnetic disturbances and their impacts on the ionosphere;
- Electron density structure and ionospheric scintillation; and
- Auroral and airglow evolution, as well as their spectroscopic emission signatures.

This program’s goals are to improve the global specification and forecasting of the evolution of ionospheric irregularities and scintillation, to improve the specification of thermospheric dynamics and neutral densities, and to validate and enhance current ionospheric models using data assimilation techniques to improve operational forecasting and specification capability.

In the space environment well above low-Earth orbit, at geosynchronous orbit and beyond, phenomena such as solar eruptive events, variable interplanetary magnetic fields, solarelectromagnetic radiation, natural space debris, cosmic rays, geomagnetic storm enhancement of Earth's radiation belts, and interplanetary dust can degrade Air Force spacecraft and systems.

In this regime, research interests include, but are not limited to:

- The physics and chemistry of meteoroids, interplanetary dust, asteroids, and comets;
- The structure and dynamics of the solar interior and their role in driving solar eruptive activity;
- The mechanism(s) heating the solar corona and accelerating it outward as the solar wind;
- The triggers of coronal mass ejections (CMEs), solar energetic particles (SEPs), and solar

flares;
- The coupling between the solar wind, the magnetosphere, and the ionosphere;
- The origin and energization of magnetospheric plasma; and
- The triggering and temporal evolution of geomagnetic storms.

The ultimate AFOSR goal is to develop a predictive, global, coupled solar-terrestrial model that connects solar activity and output with the deposition of energy in the Earth's upper atmosphere, by specifying the flow of mass, momentum, and energy through interplanetary space, and by forecasting the turbulent plasma phenomena that mediate this flow.

The AFOSR Space Sciences program is also involved in advancing deep space surveillance techniques to observe and track Near Earth Objects and other physical threats to Air Force systems. In this regard, innovative astronomical detection and observation methods that involve advanced technology are also needed. Astrophysical or astronomical research and observations that investigate stellar-planetary interactions in general, and physical processes occurring in the Sun in particular, are also of interest.

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IV. EDUCATION AND OUTREACH PROGRAMS

The External Programs and Resources Interface Division (PIE), the International Office (IO), and two overseas detachments, AOARD and EOARD, are responsible for the management of several programs that improve science and engineering education in the US, and stimulate interactions between Air Force researchers and the broader international, as well as domestic, research community. Applications for these programs do not always require proposals but generally have specific deadlines, formats, and qualifications. Researchers applying for these programs should communicate with the point(s)-of-contact listed in each program description.

United States Air Force Resident Research Associateship (USAF-RRA) Program

The RRA Program offers postdoctoral and senior scientists and engineers opportunities to perform research at sponsoring Air Force laboratory sites. The objectives of the program are (1) to provide researchers of unusual promise and ability opportunities to solve problems, largely of their own choice, that are compatible with the interests of the hosting laboratories; and (2) to contribute to the overall efforts of the Air Force laboratories.

Postdoctoral Research Associateships are awarded to U.S. citizens and permanent residents who have held doctorates for less than 5 years at the time of application. They are made initially for 1 year and may be renewed for a second year, and in some cases, a third year. A small number of associateships may be available for foreign citizens if laboratory funds are available.

Senior Research Associateships are awarded to individuals who have held doctorates for more than 5 years, have significant research experience, and are recognized internationally as experts in their specialized fields, as evidenced by numerous publications in refereed journals, invited presentations, authorship of books or book chapters, and professional society awards of international stature. Although awards to senior associates are usually for 1 year, awards for periods of 3 months or longer will be considered. Renewals for a second and third year are possible. U.S. citizenship is not a requirement. Senior associates must be eligible for access to unclassified government information systems; the Senior Research Associateship award is subject to a successful background review and visit authorization that includes approved access to the Air Force base and its laboratory facilities.

The program is currently administered by The National Research Council (NRC). Associates receive a stipend from the NRC while carrying out their proposed research. Annual stipends increase with additional years past the Ph.D. An appropriately higher stipend is offered to senior associates.

Awardees also receive a relocation reimbursement and may be supported with limited funds for professional travel.

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Research Associateship Programs (GR322A)
National Research Council
(202) 334-2760
500 Fifth St, NW
Washington DC 20001
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rap@nas.edu http://www.nationalacademies.org/rap

United States Air Force-Summer Faculty Fellowship Program (USAF-SFFP)

The SFFP offers fellowships to university faculty to conduct research at Air Force research facilities in the summer. The objectives of the Summer Faculty Fellowship Program are to (1) stimulate professional relationships among SFFP fellows and the scientists and engineers in AFRL Technical Directorates and other Air Force research facilities; (2) elevate the awareness in the US academic community of Air Force research needs and foster continued research at SFFP fellows' institutions; and (3) provide the faculty opportunities to perform high-quality research at AFRL Technical Directorates and other Air Force research facilities.

The program is currently administered by The American Society for Engineering Education (ASEE). During the summer, the fellows, in collaboration with Air Force researchers, conduct research for a continuous period of eight to twelve weeks at one of the Technical Directorates of the Air Force Research Laboratory, at the US Air Force Academy, or at Air Force Institute of Technology. A final report is required at the completion of the summer appointment.

Applicants must be US citizens or permanent residents and have an earned Ph.D. in science or engineering. Fellows must be eligible for access to unclassified government information systems; the fellowship award is subject to a successful background review and visit authorization that includes approved access to the Air Force base and its laboratory facilities.

Fellows are awarded in different categories including both early career investigator and senior investigator. The stipend is based on the category. Each SFFP award is for one summer. The SFFP fellow may reapply for up to two additional summers (3 total).

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American Society for Engineering Education
1818 N St, NW Suite 600
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http://www.asee.org.sffp

Engineer and Scientist Exchange Program (ESEP)

The Engineer and Scientist Exchange Program (ESEP) is a DOD effort to promote international cooperation in military research, development, and acquisition through the exchange of defense scientists and engineers (S&E). A prerequisite for establishing the program is a formal international agreement, a Memorandum of Understanding (MOU), with each participant nation. Currently, DoD has signed ESEP agreements with Australia, Canada, Egypt, France, Germany, Greece, Israel, Japan, Norway, Portugal, Republic of Korea, Singapore, Sweden, Spain, The Netherlands, and the United Kingdom. The primary goals of ESEP are to:

- Broaden perspectives in research and development techniques and methods.

•Form a cadre of internationally experienced professionals to enhance USAF research and development programs.
•Gain insight into foreign research and development methods, organizational structures, procedures, production, logistics, testing, and management systems.
•Cultivate future international cooperative endeavors.
•Avoid duplication of research efforts among allied nations.

Air Force personnel are selected in a competitive process and are assigned for a 2-year tour. This may be preceded by 6 months of language training. Ad hoc placements (non-competitive) can be initiated by research sites; however, these are funded solely by their originators. Foreign S&E are usually assigned to US DoD organizations for 12 month periods; although assignments can be for shorter or longer duration. Each country bears the cost of supporting its participants in the program. AFOSR/IO is responsible for managing placement of all ESEP exchangees within the USAF, and is the "one face to the customer" for all USAF ESEP actions. SAF/IAPQ (Armaments Cooperation Division, Deputy Under Secretary of the Air Force, International Affairs), the executive agent, provides policy guidance. The Asian and European Offices of Aerospace Research and Development (AOARD/EOARD) are AFOSR field offices located in Tokyo and London. These offices act as overseas program liaison offices for US ESEP personnel working in Asia and Europe.

AFOSR/IO implements all actions for USAF participants once their selection is approved, and for the placement of foreign ESEP participants in Air Force organizations.

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AF Scientist Visiting Researcher Program

The "AF Scientist Visiting Researcher Program" provides outstanding Air Force scientists and engineers the opportunity to conduct full-time, "hands-on" research-related work in leading US-university and industry laboratories for a period of up to 179 days on a temporary duty status funded by AFOSR. Upon completion of the assignment the researcher returns to his or her Air Force laboratory. The university or industrial laboratory provides a letter of invitation, and makes facilities, equipment, and resources available. The host laboratory must be located in the United States. Typically the researcher is an Air Force scientist or engineer, at least at the GS-13 level or its military equivalent. The applicant must be currently active in his or her field of expertise, be widely recognized as an expert, and have a strong publication record. The applicant must write a project proposal, preferably not to exceed 10 pages, but of sufficient depth and scope, so that it can be evaluated by the scientists at the participating organizations. Hands-on laboratory research-related work is an essential program element. The traveler is required to submit a written report detailing his or her experiences and results of the project at the completion of the TDY. In addition, the traveler may be required to give a seminar presentation at the Air Force laboratory or at AFOSR and to provide feedback for purposes of program assessment.

Window on Science (WOS) Program

The Window on Science (WOS) program facilitates technical interactions on fundamental research via direct contact between distinguished foreign researchers and Air Force Research Laboratory scientists and engineers. The WOS program sponsors foreign scientists and engineers to visit Air Force scientists and engineers at USAF sites typically within the U.S., but may also include other domestic or overseas locations. Although WOS visits are designed to be short-term in nature, visits to multiple sites are encouraged. In order to present their research to a greater audience, and to further Air Force interests, WOS visitors may also combine visits to Air Force R&D organizations with visits to Army, Navy, other government, university, or industrial facilities. The AFOSR international Detachment 1, the European Office of Aerospace Research and Development (EOARD), London, United Kingdom, manages this program for Europe, Africa, the Middle East, and countries of the former Soviet Union. Detachment 2, the Asian Office of Aerospace Research and Development (AOARD), Tokyo, Japan manage this program for the remainder of Asia and the Pacific Rim. The International Office, AFOSR/IO, located within the main body of AFOSR, manages the program for the Americas. Participants in the WOS program will be foreign researchers identified as subject matter experts by AOARD/EOARD program managers, and whose visit benefits Air Force scientists and engineers. Travelers may be eligible to receive payment for their services; however, base clearance requests for unpaid visitors can also be handled under the WOS program. Foreign military and civilian government employees are not eligible to receive financial support. Visitors will normally present seminars to discuss their work, which may or may not have been funded by the Air Force. The WOS program is not intended as a liaison officer or personnel exchange program and does not substitute for research programs, internships or associateships. The lead-time necessary to arrange a WOS visit is generally three months. A letter report from the traveler is required on completion of the visit.

EOARD: http://www.london.af.mil/
AOARD: http://www.tokyo.afosr.af.mil/
International Office: http://afosr-io.afosr.af.mil

Window on Europe (WOE), Window on Asia (WOA), and Window the Americas (WOAm) Programs

The Window on Europe, Window on Asia, and Window on the Americas programs provide outstanding Air Force scientists and engineers the opportunity to conduct full-time research at a foreign host laboratory or full-time science and technology assessment activities while based at EOARD, London, UK or AOARD, Tokyo, Japan for a period up to 179 days on temporary duty (TDY) status. The TDY is fully funded by AFOSR. Upon completion of the assignment the researcher returns to his or her Air Force activity. The host laboratory provides facilities, resources, and a letter of invitation. EOARD and AOARD provide facilities and resources for participants in the EOARD or AOARD element of the program. Typically the researcher is an Air Force scientist or engineer, at least at the GM/GS-13 level or its military equivalent. The researcher must be currently active in his or her field of expertise, be widely recognized as an expert, and have a strong publication record. Some knowledge of the language used by the researcher's host institution is desirable. The applicant must write a research proposal, preferably not to exceed 10 pages, but of sufficient depth and scope, so that it can be evaluated by the scientists at the participating organizations. The proposal must be endorsed by the applicant's Air Force Research Laboratory Technical Directorate Chief Scientist. Non-laboratory applicants, such as researchers at the Air Force Academy and Air Force Institute of Technology, should pass their proposal through the Chief Scientist of an AFRL Technical Directorate.

Proposals that focus tightly on specific research problems or specific science and technology assessment topics will merit greater consideration than those that are of a survey nature. The researcher is required to submit a written report detailing his or her research effort and findings at the completion of the TDY. In addition, the researcher may be required to give a seminar-style presentation at the Air Force laboratory and/or at AFOSR and to provide feedback for purposes of program assessment. Lead-time to set up a "Window" visit is approximately four months. More detailed information is contained in AFOSR Brochure International Window Programs, dated November 2004.

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National Defense Science and Engineering Graduate (NDSEG) Fellowship Program

The NDSEG Fellowship Program is a Department of Defense (DoD) fellowship program sponsored by Air Force Office of Scientific Research (AFOSR), Army Research Office (ARO), and Office of Naval Research (ONR). The DoD is committed to increasing the number and quality of our Nation's scientists and engineers. The actual number of awards varies from year to year, depending upon the available funding. The NDSEG Fellows do not incur any military or other service obligations. NDSEG Fellowships are highly competitive and will be awarded for full-time study and research leading to doctoral degrees in mathematics, physics, biology, ocean, and engineering sciences.

Preference will be given to applicants who indicate an intention to pursue a doctoral degree in, or closely related to, one of the following specialties: Aeronautical and Astronautical Engineering, Biosciences, Chemical Engineering, Civil Engineering, Chemistry, Cognitive, Neural and Behavioral Sciences, Computer and Computational Science, Electrical Engineering, Geosciences, Materials Science and Engineering, Mathematics, Mechanical Engineering, Naval Architecture and Ocean Engineering, Oceanography, and Physics .

The NDSEG Fellowship Program is open only to applicants who are citizens or nationals of the United States. Persons who hold permanent resident status are not eligible to apply. NDSEG Fellowships are intended for students at or near the beginning of their graduate study in science or engineering. Applications are encouraged from women, persons with disabilities and minorities, including members of ethnic minority groups such as American Indian, Black, Hispanic, Native Alaskan (Eskimo and Aleut) or Pacific Islander (Polynesian or Micronesian).

The duration of an NDSEG Fellowship is 36 months cumulative starting in the fall of an academic year. NDSEG Fellows may choose as their fellowship institution any accredited U.S. institutions of higher education offering doctoral degree in science or engineering. The availability of funds for the second and third years of each three-year award is contingent upon satisfactory academic progress.

In FY2005, NDSEG fellowships provide stipends of $30,500, $31,000 and $31,500 in years 1, 2, and 3, respectively. Additionally, the NDSEG fellowship will pay the fellow's full tuition, required fees (not to include room and board) and minimum health insurance coverage offered through the institution, up to total value of $1,000. Any excess insurance costs will be the responsibility of the fellow and can be paid using the stipend. The stipends will be prorated monthly based on a 12-month academic year. If the fellow is not enrolled in an institutionally approved academic study and/or research during the summer months, financial support will not be provided. There

are no dependency allowances. Persons with disabilities will be considered for additional allowances to offset special educational expenses.

A complete on-line application is available from the website: http://www.asee.org/ndseg. This program is currently administered by the American Society for Engineering Education (ASEE) at the following address:

NDSEG Fellowship Program
c/o American Society for Engineering Education
1818 N Street, N.W., Suite 600
Washington, D.C. 20036
(202) 331-3516 Fax: (202) 265-8504
Email: ndseg@asee.org
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V. SPECIAL PROGRAMS

AFOSR provides the support for research and education through the following unique programs: The Small Business Technology Transfer Program (STTR), the Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) Program, the University Research Initiative (URI) Programs, and conferences/workshops support other research and studies deemed appropriate by AFOSR may also be sponsored.

Small Business Technology Transfer Program (STTR)

AFOSR will have multiple topics in the FY05 DoD Solicitation cycle that will be announced around 1 February 2005. These topics are for basic research in areas of special interest to the Air Force.

The primary objective of the AF STTR program is to involve small businesses in AF-relevant defense research, and enable them to commercialize their innovative technologies for the advancement of U.S. economic competitiveness. Specifically, the STTR Program is designed to provide an incentive for small companies, academic institutions, and non-profit research institutions, including federally-funded research and development centers (FFRDC), to work together to move emerging technical ideas from the laboratory to the marketplace.

Each STTR proposal must be submitted by a team that includes a small business (as the prime contractor for contracting purposes) and at least one academic or non-profit research institution, which have entered into a Cooperative Research and Development Agreement for the proposed effort. The STTR has two phases. Phase I efforts are up to $100,000 for a period not to exceed one year. Phase II projects are less than 24-month efforts for amounts up to $750,000. More information regarding the AF STTR can be found at: http://www.afrl.af.mil/sbir.

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Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) Program

AFOSR HBCU/MI program consists of two main components:

AFOSR Core Research. Research proposals from HBCU/MI are reviewed by AFOSR Program Managers as part of their core program and may be funded from funds set aside by the AFOSR Director.

Department of Defense Infrastructure Support Program for Historically Black Colleges and Universities and Minority Institutions. The DoD has been providing grants for research and educational equipment at HBCU/MI. This program is administered by the Army Research Office, in collaboration with the Air Force Office of Scientific Research. Schools interested in this program should look for the Broad Agency Announcement that is usually published in October each year in the ARO webpage. The BAA is linked through the AFOSR webpage (http://www.afosr.af.mil). Grants under this program are for one year and range from $20,000 to $200,000.

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UNIVERSITY RESEARCH INITIATIVE (URI) PROGRAMS

The URI Special programs are executed under the policy guidance of the Office of the Deputy Under Secretary of Defense for Laboratories and Basic Research, to enhance universities' capabilities to perform basic science and engineering research and related education in science and engineering areas critical to national defense. The URI programs include: the Defense Research Instrumentation Program (DURIP); the Multidisciplinary Research Program of the University Research Initiative (MURI); the Defense University Research Initiative on NanoTechnology (DURINT); and the Critical Infrastructure Protection (CIP) and High Confidence, Adaptive Software (SW) program. A short description of each program is listed below. Specific information on each URI program Broad Agency Announcement can be found on the AFOSR Web site at http://www.afosr.af.mil, under “Research Opportunities”.

Defense University Research Instrumentation Program (DURIP)

This program is administered through the Air Force Office of Scientific Research, the Army Research Office, and the Office of Naval Research. The DURIP program is for the acquisition of major equipment to augment current or develop new research capabilities to support research in the technical areas of interest to the DoD. The competition is open only to U.S. institutions of higher education, with degree granting programs in science, math, and/or engineering. Proposals to purchase instrumentation may request $50,000 to $1,000,000. Awards are typically one year in length.

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Multidisciplinary Research Program of the University Research Initiative (MURI)

This program is administered through the Army Research Office, the Office of Naval Research, and the Air Force Office of Scientific Research. The Multidisciplinary Research Initiative (MURI) supports university research efforts intersecting more than one traditional science and engineering discipline. Multidisciplinary research teaming not only accelerates research progress in areas particularly suited to this approach by cross-fertilization of ideas but also help to hasten the transition of basic research findings to practical application. By supporting team efforts, MURI complements other DoD programs that support university research through single-investigator awards. Awards are typically for a period of three years with two additional years possible as options. The funding level ranges typically from $0.5M to $1M per year. The MURI is competed in specific research topics described in the current MURI announcement at http://www.afosr.af.mil, under “Research Opportunities”.

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Defense University Research Initiative on NanoTechnology (DURINT)

This program is administered through the Army Research Office, the Office of Naval Research, and the Air Force Office of Scientific Research. DURINT supports university teams to conduct basic research on nanotechnology. Through team efforts, the DURINT program complements other DoD research programs on nanotechnology that support university research through single-investigator awards. DURINT is a multidisciplinary research program, which calls for proposals either jointly with MURI or on a separate BAA.

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Critical Infrastructure Protection (CIP) and High Confidence, Adaptive Software (SW) University Research Initiative

This program is administered through the Army Research Office, the Office of Naval Research, and the Air Force Office of Scientific Research. The CIP/SW URI supports university team research to achieve the overall goal of information superiority for the war fighter. CIP/SW is a multidisciplinary research program, which calls for proposals either jointly with MURI or on a separate BAA.

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The Department of Defense Experimental Program to Stimulate Competitive Research (DEPSCoR)

The program is sponsored by the Office of the Deputy Under Secretary of Defense for Laboratories and Basic Sciences [ODUSD(LABS)] and is administered through the ARO, ONR, and AFOSR with the cooperation of the Experimental Program to Stimulate Competitive Research (EPSCoR) State Committees. The DoD, including AFOSR, plans to award fiscal year 2005 DEPSCoR appropriations through the DEPSCoR announcement.

DEPSCoR objectives are to: (1) enhance the capabilities of institutions of higher education ("universities") in eligible States to develop, plan, and execute science and engineering research that is competitive under the peer-review systems used for awarding Federal research assistance; and (2) increase the probability of long-term growth in the competitively awarded financial assistance that universities in eligible States receive from the Federal Government for science and engineering research. Consistent with these long-term objectives of building research infrastructure, the DoD intends to competitively make multiyear awards for research and for associated graduate education of scientists and engineers in areas important to national

defense. Only National Science Foundation (NSF) EPSCoR State Committees may submit proposal packages in response to the DEPSCoR announcement. Universities in EPSCoR States/territories with degree granting programs in science, mathematics, and/or engineering are eligible to submit proposals for DEPSCoR research grants via their EPSCoR State Committee. Each EPSCoR State Committee may submit a proposal package containing up to five (5) separately fundable proposals requesting support from DoD for a 36-month period. Within the state proposal package, all proposals must request a minimum of $350,000. To maximize the DEPSCoR program objectives, all DEPSCoR awards require an annual minimum non-federal cost sharing or matching of one-to-two (i.e., at least one dollar from State, institutional, and/or private sector sources to match each two dollars of DEPSCoR support being provided). Matching funds may support items such as salaries, indirect costs, operating expenses, or new equipment. Universities in 22 States and Territories are eligible to receive awards under this announcement.

STATES AND TERRITORIES CURRENTLY ELIGIBLE FOR DEPSCoR AWARDS

Alaska	Arkansas	Delaware	Hawaii	Idaho
Kansas	Kentucky	Maine	Montana	Puerto Rico
Nebraska	Nevada	North Dakota	Oklahoma	Rhode Island
South Carolina	South Dakota	Tennessee	Vermont	West Virginia
Wyoming	U.S. Virgin Islands			

DEPSCoR research projects may address any of the technical areas listed in the BAA. BAAs and program descriptions are available on-line at the following addresses:

Air Force Office of Scientific Research:
http://www.afosr.af.mil (select “Research Opportunities”)

U.S. Army Research Office:
http://www.aro.army.mil (select “Funding Opportunities”)

Office of Naval Research:
http://www.onr.navy.mil (select “Science and Technology)

Proposals to perform research in listed technical areas, or other areas important to national defense, will be considered. For detailed information regarding technical goals, potential offerors are advised to consult these announcements and to contact DoD program managers listed therein to explore possible mutual interest before submitting proposals.

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Presidential Early Career Award in Science & Engineering (PECASE)

The National Science & Technology Council (NTSC) sponsors PECASE awards to recognize outstanding young scientists and engineers at the outset of their careers. The PECASE embodies the high priority placed by the President on maintaining the leadership position of the US in science by producing outstanding scientists and engineers and nurturing their continued

development. The Awards will identify a cadre of outstanding scientists and engineers who will broadly advance science and the missions important to the participating agencies.

The PECASE recognize some of the nation's finest scientists and engineers who, while early in their research careers, show exceptional potential for leadership at the frontiers of scientific knowledge during the 21st century. The Awards foster innovative and far-reaching developments in science and technology, increase awareness of careers in science and engineering, give recognition to the scientific missions of participating agencies, enhance connections between fundamental research and national goals, and highlight the importance of science and technology for the nation's future. The awards are conferred annually at the White House following recommendations from participating agencies.

To be eligible for the PECASE, an individual must be a US citizen, national, or permanent resident with no more than five years from receipt of the doctorate degree. Each award will be $100K per year for five years. AFOSR awardees will be selected from among highly qualified institute-of higher-education principal investigators to the AFOSR or former National Defense Science and Engineering Graduate (NDSEG) fellowship recipients. Candidates must hold tenure-track positions at U.S. universities. An individual wishing to apply for the program must be nominated by the AFOSR program manager and have a proposal that addresses Air Force research interests as described in the current AFOSR Broad Agency Announcement (BAA).

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Partnerships for Research Excellence and Transition (PRET)

The PRET Program is a university-based research program of excellence involving strong industrial ties to accelerate the transition of research results to industry. This program is designed to broaden the university base in support of defense research, strengthen university-industry cooperation, and improve the US competitiveness in areas of dual use. The goal of the program is to fund quality research and concurrently establish and support a deliberate exchange of scientific personnel between academia and industry. The areas to be supported are found in Section III of this announcement. Proposals will be evaluated using the following criteria. The first three factors are of equal importance to each other. The last factors are of lesser importance than the first three, but are of equal importance to each other.

1. The scientific and technical merits of the proposed research.
2. The potential contributions of the proposed research to the mission of the Air Force.
3. The proposed interface between university and industry for the purpose of transitioning the generated information.
4. The likelihood of the proposed effort to develop new research capabilities and broaden the research base in support of national defense.
5. The proposer's key personnel qualifications, capabilities, related experience, facilities, or techniques or a combination of these factors that is integral to achieving Air Force Objectives.
6. The proposer's and associated personnel's record of past performance.
7. The realism and reasonableness of proposed costs and availability of funds. Although not a primary evaluation factor, price is a substantial factor in the selection of proposals for award.

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Conferences and Workshops

The Air Force Office of Scientific Research (AFOSR) understands that it is essential for the scientific community to maintain clear lines of communication for thorough and well-reasoned research to be accomplished. Support for conferences and workshops has proven to be an extremely valuable tool for AFOSR. They allow our technical managers the opportunity to receive current information in their respective disciplines. They also allow AFOSR the opportunity to inform the research community of the current thrust of AFOSR's programs. Conferences and workshops constitute a key forum for research and technology interchange.

AFOSR accepts proposals from all recognized scientific, technical, or professional organizations that qualify for federal tax-exempt status.

AFOSR's financial support through appropriate financing vehicles for conferences and workshops is dependent on the availability of funds, program manager's discretion, and certain other restrictions including:

- AFOSR support for a workshop or conference is not to be considered as an endorsement of any co-sponsoring organization, profit or non-profit.
- The subject matter of the conference or workshop is scientific, technical, or involves professional issues that are relevant to AFOSR's mission of managing the Air Force basic research program.
- The purpose of our support is to transfer federally developed technology to the private sector or to stimulate wider interest and inquiry into the relevant scientific, technical, or professional issues relevant to AFOSR's mission of managing the Air Force basic research program.

Proposals for conference or workshop support should be submitted a minimum of six months Prior to the date of the conference. Proposals should include the following:

Technical Information:

- Summary indicating the objective(s) of the conference/workshop
- Topic(s) to be covered and how they are relevant to AFOSR's mission of managing the Air Force basic research program
- Title, location, and date(s) of the conference/workshop
- Explanation of how the conference/workshop will relate to the research interests of AFOSR identified in Section III of the Broad Agency Announcement (BAA)
- Chairperson or principal investigator and his/her biographical information
- List of proposed participants and method (or copies) of announcement or invitation
- A note whether foreign nationals will be present

Cost Information:

- Total project costs by major cost elements
- Anticipated sources of conference/workshop income and amount from each

•Anticipated use of funds requested from AFOSR

Proposals for conferences and workshops will be evaluated using the following criteria. All factors are of equal importance to each other:

•The scientific and technical relevance of the proposed conference.
•The potential contributions of the proposed conference to the mission of the Air Force.
•The qualifications of the principal investigator(s) or conference chair(s).
•The realism and reasonableness of cost including proposed cost sharing and availability of funds.

If you have questions concerning the scientific aspects of a potential proposal to AFOSR for conference or workshop support, please contact the program manager listed in Section III of the BAA responsible for the particular scientific area of the conference/workshop. If you have questions concerning the eligibility of your organization to receive funding for your conference or workshop, please contact the AFOSR Legal Office at (703) 696-9500.

VI. PROPOSAL GUIDANCE

PROPOSAL GUIDANCE

The Air Force Office of Scientific Research (AFOSR) invites proposals for basic and applied research in support of the Air Force Defense Research Sciences Program. Proposers selected for funding may be awarded grants, cooperative agreements, or contracts. The areas of interest are covered in Sections III, IV, and V of this pamphlet. This includes proposals for research instrumentation that will support research in areas of interest to the Air Force and DOD. Procedures for a researcher to apply for programs noted in Sections III, IV, and V are specific to each program. Information and proposal procedures can be requested from the office noted in each program description.

AFOSR's overriding purpose in supporting this research is to advance the state of the art in areas related to the technical problems the Air Force encounters in developing and maintaining a superior Air Force; lowering the cost and improving the performance, maintainability, and supportability of Air Force weapon systems; and creating and preventing technological surprise.

Proposals submitted under this Broad Agency Announcement (BAA) are evaluated through a peer or scientific review process, and selected for award on a competitive basis according to Public Law 98-369, Competition in Contracting Act of 1984, 10 U S C 2361, and 10 U S C 2374. Proposals may be evaluated by program managers at EOARD/AOARD and the appropriate AFRL Technology Directorates. Additionally, proposals may also be evaluated by outside evaluators retained by AFOSR. Proposals submitted for Special Programs listed in Section V shall be evaluated under criteria as specified in their description. Subject to fund availability, all other proposals will be evaluated under the following two primary criteria, of equal importance, as follows:

1. The scientific and technical merits of the proposed research.
2. The potential contributions of the proposed research to the mission of the USAF.

Other evaluation criteria used in the technical reviews, which are of lesser importance than the primary criteria and of equal importance to each other, are:

1. The likelihood of the proposed effort to develop new research capabilities and broaden the research base in support of US national defense.
2. The proposer's, principal investigator's, team leader's, or key personnel's qualifications, capabilities, related experience, facilities, or techniques or a combination of these factors that are integral to achieving USAF objectives.
3. The proposer's and associated personnel's record of past performance.
4. The realism and reasonableness of proposed costs.

No further evaluation criteria will be used in source selection. The technical and cost information will be analyzed simultaneously during the evaluation process.

Proposals may be submitted for one or more topics or for a specific portion of one topic. A proposer may submit separate proposals on different topics or different proposals on the same topic. The US Government does not guarantee an award in each topic area. Further, be advised that as funds are limited, otherwise meritorious proposals may not be funded. Therefore, it is important that proposals show strength in as many of the evaluation areas as practicable for maximum competitiveness.

This section is to be used in conjunction with the *AFOSR Proposer's Guide,* located at http://www.afosr.af.mil/oppts/afrprop.htm, for submitting a proposal in response to this announcement.

The cost of preparing proposals in response to this announcement is not considered an allowable direct charge to any award made under this BAA or to any other award. It may, however, be an allowable expense to the normal bid and proposal indirect cost. Only Contracting/Grants Officers are legally authorized to commit the US Government to an award under this BAA.

Technology sharing and transfer is encouraged; in this respect, AFOSR welcomes proposals that envision university-industry cooperation. Nonindustry proposers are encouraged to specify in their proposals their interactions with industry and the Air Force Research Laboratory's Technical Directorates, including specific points of contact. Cooperation with or use of facilities of the Air Force Research Laboratory is also encouraged. Personnel interaction (e.g., university faculty or students performing research at industry or Air Force Research Laboratory sites; industry or Air Force staff working in university laboratories) is viewed as highly desirable. Further information regarding the Air Force Research Laboratory may be viewed at http://www.afrl.af.mil/.

Central Contractor Registration

(a) Definitions:

"Central Contractor Registration (CCR) database" - the primary Government repository for information required for the conduct of business with the Government.

"Data Universal Numbering System (DUNS) number" - assigned by Dun and Bradstreet, Inc. (D&B) to identify unique business entities.

"Data Universal Numbering System+4 (DUNS+4) number" - the DUNS number assigned by D&B plus a 4-character suffix that may be assigned by a business concern. (D&B has no affiliation with this 4-character suffix.) This 4-character suffix may be assigned at the discretion of the business concern to establish additional CCR records for identifying alternative Electronic Funds Transfer (EFT) accounts for the same parent concern.

"Registered in the CCR database" means that the offeror has entered all mandatory information, including the DUNS number or the DUNS+4 number, into the CCR database; and the Government has validated all mandatory data fields and has marked the record "Active".

(b) Notes:

(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee shall be registered in the CCR database prior to award, during performance, and through final payment of any award resulting from this announcement.

(2) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" or "DUNS+4" followed by the DUNS or DUNS+4 number that identifies the offeror's name and address exactly as stated in the offer. The DUNS number will be used by the Contracting/Grants Officer to verify that the offeror is registered in the CCR database.

(c) If the offeror does not have a DUNS number, he or she should contact Dun and Bradstreet directly to obtain one.

(d) Processing time, which normally takes 48 hours, should be taken into consideration when registering. Offerors who are not registered should consider applying for registration immediately upon receipt of this solicitation.

(e) Offerors may obtain information on registration and annual confirmation requirements via the Internet at http://www.ccr.gov or by calling 1-888-227-2423, or 269-961-5757.

Certifications

All awards require some form of certifications of compliance with national policy requirements.

For assistance awards, i.e., grants and cooperative agreements, some certifications (e.g., the certification of lobbying) are to be submitted at the time of proposal, rather than at the time of award. Proposers may incorporate these certifications into their proposals by reference. This may be accomplished by using AFOSR's proposal cover page: http://www.afosr.af.mil/docs/afrgcvr.doc.

The current certification for assistance awards is available at AFOSR's World Wide Web site at: http://www.afosr.af.mil/pdfs/May2004assistancecerts.pdf.

For contract awards, prospective contractors shall complete electronic annual representations and certifications at http://www.bpn.gov/orca in conjunction with required registration in the Central Contractor Registration (CCR) database. Prospective contractors shall update the representations and certifications submitted to ORCA as necessary, but at least annually, to ensure they are kept current, accurate, and complete. The representations and certifications are effective until one year from date of submission or update to ORCA.

Marking of Proposals

Every effort will be made to protect the confidentiality of the proposal and any evaluations. However, under the Freedom of Information Act (FOIA) requirements, such information (or portions thereof) may potentially be subject to release. The proposer must mark the proposal with a protective legend found in FAR part 15.6, Use and Disclosure of Data, (modified to permit release to outside evaluators retained by AFOSR) if protection is desired for proprietary or confidential information.

Other Information

Proposals should briefly address whether the intended research will result in environmental impacts outside the laboratory, and how the proposer will ensure compliance with environmental statutes and regulations. Unnecessarily elaborate brochures or presentations beyond those sufficient to present a complete and effective

proposal are not desired. Proposals may be submitted as hard copy or by electronic media (floppy disk or CD-ROM in Word or Portable Document File (PDF) format). A signed copy of AFOSR's Proposal Cover Sheet should be submitted with all proposals. case of difficulties in determining the appropriate AFOSR addressee, proposals may be submitted to:

AFOSR/PKC
4015 Wilson Blvd, Room 713
Arlington VA 22203-1954

For additional guidance on the form and content of proposals, proposers should refer to the "How to Apply for a Grant or Contract" selection, which can be located in the "Doing Business with AFOSR" section of our World Wide Web site, http://www.afosr.af.mil.

This announcement is AFOSR BAA 2005-1 and supersedes AFOSR BAA 2004-1, Research Interest Brochure. This announcement is open-ended until revised and should be referenced on all responses.